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(12)

EUROPEAN PATENT APPLICATION

(21) Application number: 87830112.6

(51) Int. Cl.⁴: **B 61 D 27/00**

(22) Date of filing: 23.03.87

(30) Priority: 25.03.86 IT 6723686

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(43) Date of publication of application: 30.09.87
Bulletin 87/40

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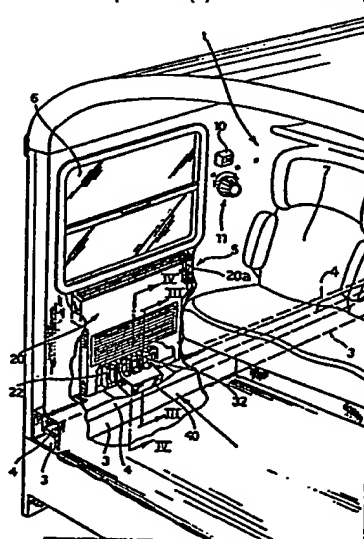
(84) Designated Contracting States: **AT BE CH DE ES FR GB GR IT LI LU NL SE**

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(54) **Air diffuser for air-conditioning system for the compartments of railway carriage.**

(57) In an air-conditioning system for the compartments (1) of a railway carriage, an air-treatment unit (2) housed in a casing suspended beneath the carriage, supplies a flow of hot or cold air and a flow of hot air, respectively, to at least one primary pipe (3) and at least one secondary pipe (4) extending along a wall of the carriage through the passenger compartments (1). An air diffuser (5) is connected to the primary and secondary pipes (3, 4) in each compartment (1). This diffuser (5) defines a mixing chamber (21) which is in permanent communication with the primary pipe (3) and can communicate with the secondary pipe (4) in a manner controlled by electrically-operated switch means (13, 41). The mixing chamber (21) communicates with the interior of the compartment (1) through an air inlet aperture (8) and an outlet aperture (9). The mixing chamber (21) communicates with the primary pipe (3) and the secondary pipe (4), respectively, through first and second pluralities of nozzles (22, 32), preferably of the converging-diverging type, mounted in the lower part of the chamber (21). The air inlet and outlet apertures (8, 9) of the mixing chamber (21) are formed close to the outlet end of the nozzles (22, 32) and above these nozzles (22, 32), respectively, so that, in operation, the air flow issuing from the nozzles (22, 32) induces an air flow from the compartment (1) to the mixing chamber (21) through the inlet aperture (8) mixes in the chamber (21) with the induced

return flow, and then diffuses into the compartment (1) through the outlet aperture (9) of the chamber (21).



Air diffuser for air-conditioning systems for the compartments of a railway carriage

The subject of the present invention is an air diffuser for use in an air-conditioning system for the compartments of a railway carriage suitable for transporting passengers. More particularly, the
5 invention concerns an air diffuser for an air conditioning system comprising an air-treatment unit carried by the carriage and arranged to supply a flow of hot or cold air and a flow of hot air, respectively, to at least one primary pipe and at least one secondary
10 pipe extending along a wall of the carriage through the compartment; an air diffuser connected to the pipes in each compartment and defining a mixing chamber which communicates permanently with the primary pipe and which can communicate with the secondary pipe in a
15 manner controlled by electrically-operated switch means; the mixing chamber communicating with the interior of the compartment through at least one air inlet aperture and at least one outlet aperture.

The object of the present invention is to provide an air
20 diffuser of the type indicated above, which enables the temperature of the air in the compartment to be regulated more effectively, so as to create turbulent conditions in the compartment for eliminating or at least considerably reducing stagnation of the air and
25 thus achieving more uniform and homogeneous distribution of the air temperature in the compartment.

This object is achieved according to the invention by means of an air diffuser of the type specified above, the main characteristic of which lies in the fact that
30 the mixing chamber communicates with the primary pipe and can communicate with the secondary pipe,

respectively, through first and second plurality of nozzles, preferably of the converging-diverging type, mounted in the lower part of the chamber, and in that the air inlet and outlet apertures of the mixing
5 chamber are formed close to the outlet end of the nozzles and above the nozzles, respectively, so that, in operation, the air flow issuing from the nozzles induces an air flow from the compartment to the mixing chamber through the inlet aperture, mixes in
10 the chamber with the induced return flow, and then diffuses into the compartment through the outlet aperture from the chamber.

Further characteristics and advantages of the diffuser according to the invention will become apparent from the
15 detailed description which follows with reference to the appended drawings, provided purely by way of non-limiting example, in which:

Figure 1 shows schematically an air-conditioning system for the compartments of a railway carriage,

20 Figure 2 is a partially-sectioned perspective view of part of a compartment provided with a diffuser according to the invention,

Figure 3 is a sectional view taken on the line III-III of Figure 2,

25 Figure 4 is a sectional view taken on the line IV-IV of Figure 2,

Figure 5 is a perspective view taken on the arrow V of Figure 2, showing a series of nozzles forming part of the diffuser of the invention on an enlarged scale, and

Figure 6 is a section taken on the line VI-VI of Figure 5, on an enlarged scale.

In Figure 1 the compartments of a railway carriage for the transport of passengers are schematically indicated 1. An air-conditioning system is provided for the compartments 1 which, in known manner, comprises an air-treatment unit 2 housed in a casing suspended beneath the carriage. This unit includes heating devices and a cooling system including an evaporator and, still in known manner, is arranged to supply hot or cold air to a primary pipe 3 and hot air to a secondary pipe 4. The pipes 3 and 4 run in parallel with each other close to the floor of the compartments 1, along the wall P of the carriage adjacent which the compartments are formed.

An air diffuser, generally indicated 5, is connected to the pipes 3 and 4 in each compartment 1. In the embodiment illustrated, each diffuser 5 is located in the wall P of the carriage beneath the window 6 of the compartment, in the zone between the facing seats or couches 7. Each air diffuser 5 has an aperture in its lower part which is closed by an intake shutter 8. Immediately beneath the window 6 of the compartment, each diffuser 5 has an air outlet aperture in its upper part, provided with a grille 9.

Each compartment 1 also has a temperature sensor 10 and a manually-operable regulating device 11 including, for example, a potentiometer. The sensors 10 and the regulating devices 11 for the various compartments are connected to a control unit 12 normally installed close to a vestibule of the carriage. This unit is connected to the air-treatment unit 2 and to actuator devices,

indicated 13 in Figure 1, arranged in each diffuser 5 in the compartment 1 and intended, as will be described in greater detail below, to control the supply of hot air to the diffuser 5 through the secondary pipe 4.

5 In known manner, the unit 12 is arranged to control the operation of the air-treatment unit 2 so that the diffuser devices 5 of the compartment are supplied with cold or hot air through the primary pipe 3 to keep the temperature at a predetermined average value, for
10 example, 17.5°C. The passengers can operate the control unit 12 by means of the regulating device 11 to cause the supply of more or less cold or hot air, so as to bring the temperature in the compartment to a value set by the passengers and to keep it at this
15 temperature. The sensors 10 provide the unit 12 with signals indicative of the temperature in the compartment at any instant.

As shown particularly in Figures 2 to 4, the air diffuser according to the invention includes a
20 flattened box-shaped body 20 having an upper aperture 20a directed essentially along the lower side of the window 6 and provided with the grille 9 already described with reference to Figure 1.

In the embodiment illustrated, the primary pipe 3 has a
25 substantially L-shaped cross-section, while the secondary pipe 4 has a substantially rectangular section and is arranged in the recess of the section of the pipe 3.

The body 20 has a lower aperture 20b parallel to and
30 facing the upper aperture 20a. The body 20 is fixed to the upper face of the primary pipe 3 in correspondence

with this aperture, as shown in Figure 3, and its lower aperture 20b faces three spaced-apart rectangular apertures 3a formed in the upper wall of the primary pipe 3 and illustrated in broken outline in Figure 5.

5 Within the body 20 is a mixing chamber 21. Within this chamber, above the apertures 3a in the upper wall of the pipe 3, are three nozzles each of which is generally indicated 22 (Figures 3 and 5). These nozzles are formed by a pair of lateral channel members 23 disposed
10 with their respective concavities facing each other and having a width which increases gradually from the bottom to the top. Each nozzle 22 also includes a pair of shaped plates 24 and 25 facing the channel members 23. At their roots, these plates are riveted
15 or welded to the side walls of the channel members 23. The plates 24 and 25 are constituted, for example, by two sheet metal pieces and, by virtue of their relative elasticity, their upper ends can be brought closer together or moved away from each other in
20 a manner which can be controlled accurately by means of a regulating device 26 (Figures 3 and 6). This device includes a screw 27 fixed to one plate and extending through a bush 28 located in a hole in the other, and a nut 29 screwed onto the free end of the screw. The
25 device 26 enables micrometric regulation of the distance between the upper portions of the plates 24 and 25 to be achieved. These latter, as shown particularly in Figure 3, are shaped so as to define a between them a passage which, in a plane transverse the
30 direction of the pipe 3 and 4, has a section which tapers gradually from the bottom to the top until it reaches a minimum width in a throat region before widening again upwardly. In other words, the channel members 23 and the shaped plates 24 and 25 of each

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nozzle 22 form a converging-diverging nozzle between the primary pipe 3 and the mixing chamber 21 defined in the body 20.

As shown particularly in Figure 5, the nozzles 22
5 connected to the primary pipe 3 alternate with further
nozzles 32 which bear on portions of the upper wall of
the primary pipe 3 between the apertures 3a. The
nozzles 32 do not therefore communicate with the
primary pipe 3 as shown in Figure 4. Each nozzle 32
10 also includes two facing lateral channel members. On
their sides facing the compartment, the lateral walls
of these channel members 33 are connected to a
substantially parallelepipedal box-like body 40
(Figures 4 and 5) fixed above the secondary pipe 4.
15 Each nozzle 32 includes a shaped plate 34 of a shape
similar to that of the plates 24 of the nozzles 22 and
a shaped front plate 35 whose lower portion is curved
and welded to the upper wall of the box-like body 40.
The upper walls of the shaped plates 34 and 35 are held
20 at a distance apart which can be adjusted precisely by
means of a regulating device 36 similar to that
described previously with reference to the nozzles 22.
The body 40 is also made, for example, of sheet metal
and, in its wall facing the nozzles 32, has two
25 apertures 40a in correspondence with the nozzles,
illustrated in broken outline in Figure 5. The
interior of the body 40 communicates with the nozzles
32 through these apertures.

Two rectangular apertures 40b are formed in the base
30 wall of the body 40 and face corresponding apertures 4a
formed in the secondary pipe 4 (Figure 4). Each
aperture 40b is associated with a respective obturator
member 41 articulated at 42 to the base wall of the body

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40. Mounted in the body 40 between the obturators is an electromagnet 13 the movable armature 13a of which is coupled kinematically to the obturators 41. The electromagnets 13 are controlled by the control unit 12, as shown in the diagram of Figure 1. The energisation of the electromagnets causes the movement of the obturators 41 into the position in which they open the basal apertures in the box-like body 40. In the energised condition of the electromagnets 13, the nozzles 22 are thus put into communication with the secondary pipe 4 and hot air can therefore be supplied to the mixing chamber 21 through the nozzles. To advantage, the control unit 12 may be arranged to allow the electromagnets 13 to be controlled in a variable duty cycle to vary correspondingly the quantity of hot air taken from the secondary pipe 4 and delivered to the mixing chamber 21.

From what has been explained above, it is clear that, while the nozzles 22 are in permanent communication with the pipe 3, the nozzles 32 are normally disconnected from the pipe 4 with which they communicate only when the electromagnets 13 are energised.

The intake shutter 8 is fixed in the front wall of the body 20 facing the outlet ends of the nozzles 22 and 32 and the region immediately overlying the mixing chamber 21 (Figures 3 and 4). This shutter includes a plurality of superposed blades 45 arranged horizontally. As shown in Figures 3 and 4, the blades 45 have a curved profile with the concavity facing upwardly, and are inclined upwardly towards the mixing chamber 21.

In operation, the air (hot or cold) from the primary pipe 3 flows to the mixing chamber 21 of the diffuser

device 5 of each compartment through the nozzles 22. The effect of these nozzles is to speed up the flow of air into the chamber 21. If necessary, the control unit 12 energises the
5 electromagnets 13 so that a further flow of hot air is fed into the chamber 21 through the nozzles 32.

In each compartment, the air flow issuing from the nozzles 22 and/or 32 draws an air flow from the lower region of the compartment into the mixing chamber 21 by
10 induction through the intake shutter 8, as indicated by the arrows F in Figures 3 and 4. In the chamber 21, the air flow from the nozzles 22-32 mixes with the flow induced by induction through the grille 8 and the resulting flow proceeds upwardly to return to the
15 compartment through the outlet grille 9 of the diffuser device 5. The air flow from the nozzles 22-32 thus tends to create a circulation of air within the compartment, preventing stagnation and leading to a better and more homogeneous distribution of the air
20 temperature in the compartment.

The intake grille 8 of each diffuser device 5 is preferably removable so as to allow inspection of the nozzles 22-32. The outlet section of the latter may be varied by means of the regulating device 26-36 to
25 compensate for load losses which occur along the primary and secondary pipes 3 and 4 further away from the air-treatment unit 2.

The elongate form of the section of the nozzles 22-32 improves the action of returning the air flow from the
30 compartment to the mixing chamber 21 and reduces noise by virtue of the modest loss of load introduced by these nozzles.

CLAIMS

1. Air diffuser for an air-conditioning system for the compartments (1) of a railway carriage, comprising an air-treatment unit (2) for supplying a flow of hot or cold air and a flow of hot air, respectively,
5 to at least one primary pipe (3) and at least one secondary pipe (4) extending along a wall of the carriage through the compartments (1); an air diffuser (5) being connected to the pipes (3, 4) in each compartment and defining a mixing chamber (21) which
10 communicates permanently with the primary pipe (3) and which can communicate with the secondary pipe (4) in a manner controlled by electrically-operated switch means (13, 41); the mixing chamber (21) communicating with the interior of the compartment (1) through at
15 least one air inlet aperture (8) and at least one outlet aperture (9); the diffuser (5) being characterised in that the mixing chamber (21) communicates with the primary pipe (3) and can communicate with the secondary pipe (4), respectively,
20 through first and second pluralities of nozzles (22;32), preferably of the converging-diverging type, mounted in the lower part of the chamber (21), and in that the air inlet and outlet apertures (8, 9) are formed close to the outlet end of the nozzles (22; 32) and above the
25 nozzles (22; 32), respectively, so that, in operation, the air flow issuing from the nozzles (22; 32) induces an air flow from the compartment (1) to the mixing chamber (21) through the inlet aperture (8), mixes in the chamber (21) with the induced return flow, and then
30 diffuses into the compartment (1) through the outlet aperture (9) from the chamber (21).

2. Diffuser according to Claim 1, characterised in that each nozzle (22; 32) has an outlet aperture which is

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elongate parallel to the axis of the pipes (3, 4).

3. Diffuser according to Claim 1 or Claim 2, characterised in that each nozzle (22; 32) has means (26; 36) for adjusting the outlet aperture.

5 4. Diffuser according to any one of the preceding claims, characterised in that each nozzle (22; 32) includes a pair of facing channel members (23; 33) and a pair of plates (24, 25; 34, 35) located between the channel members (23; 33) and shaped so as to define
10 between them a passage which has a gradually tapering width.

5. Diffuser according to Claim 4, characterised in that the shaped plates (24, 25; 34, 35) define between them a passage having a minimum width in a throat zone between
15 two divergent end portions.

6. Diffuser according to any one of the preceding claims, characterised in that the inlet aperture of the mixing chamber (21) has a shutter (8), preferably removable, including a plurality of superposed blades
20 (45) which are located in a substantially vertical plane, have a curved profile with the concavity facing upwardly, and are inclined upwardly towards the mixing chamber (21).

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FIG. 1

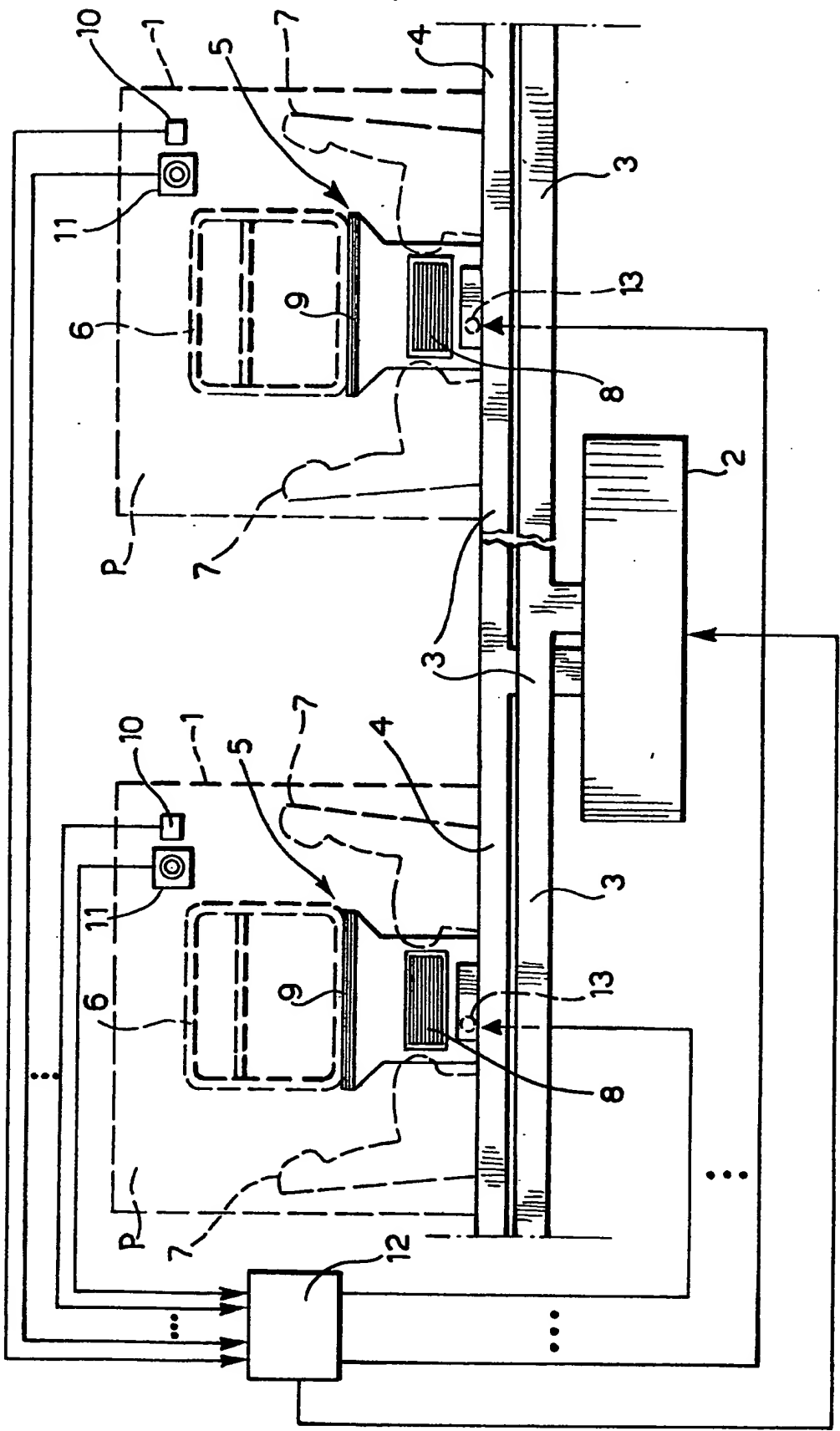
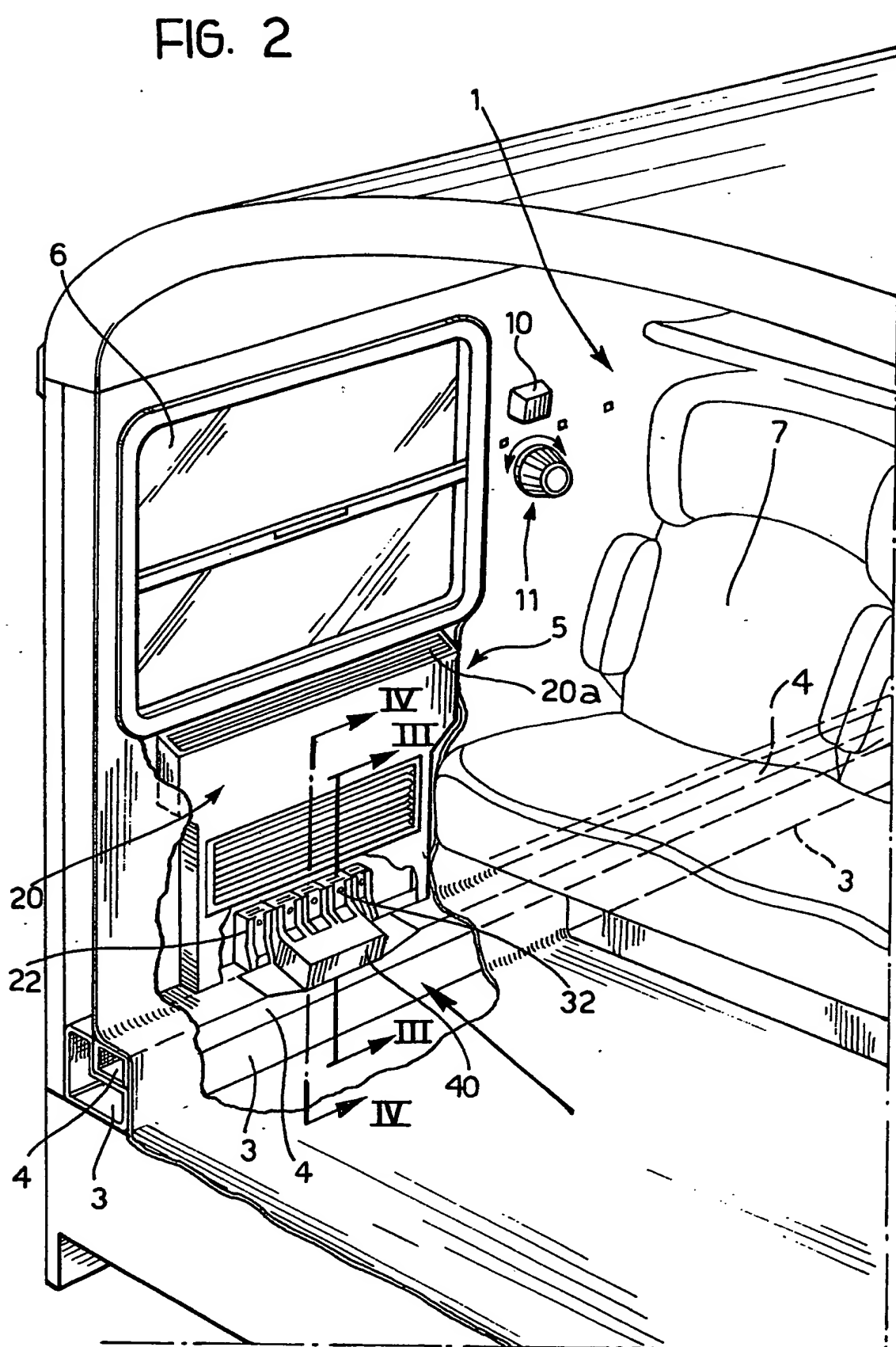
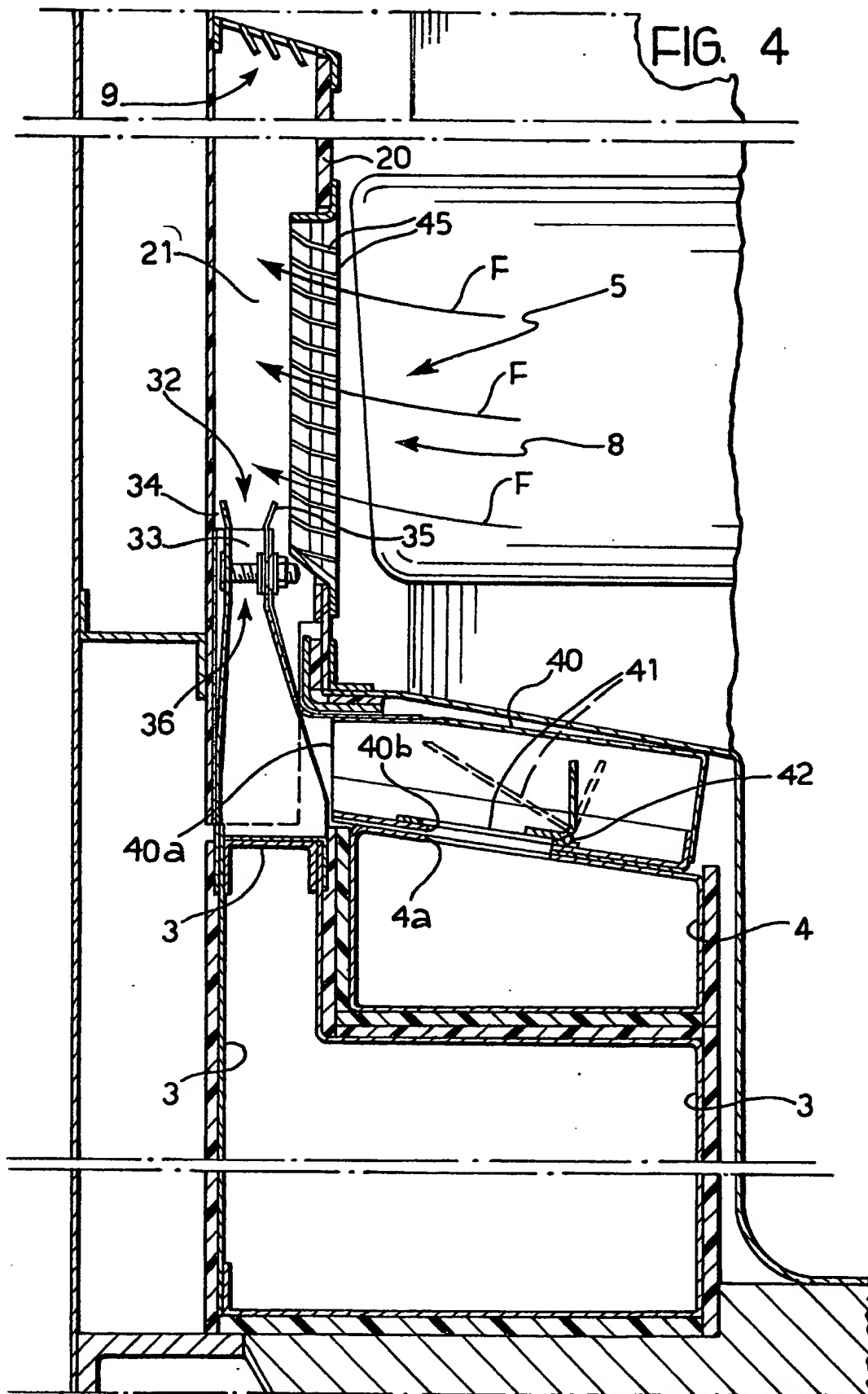


FIG. 2





5. 6. 7.

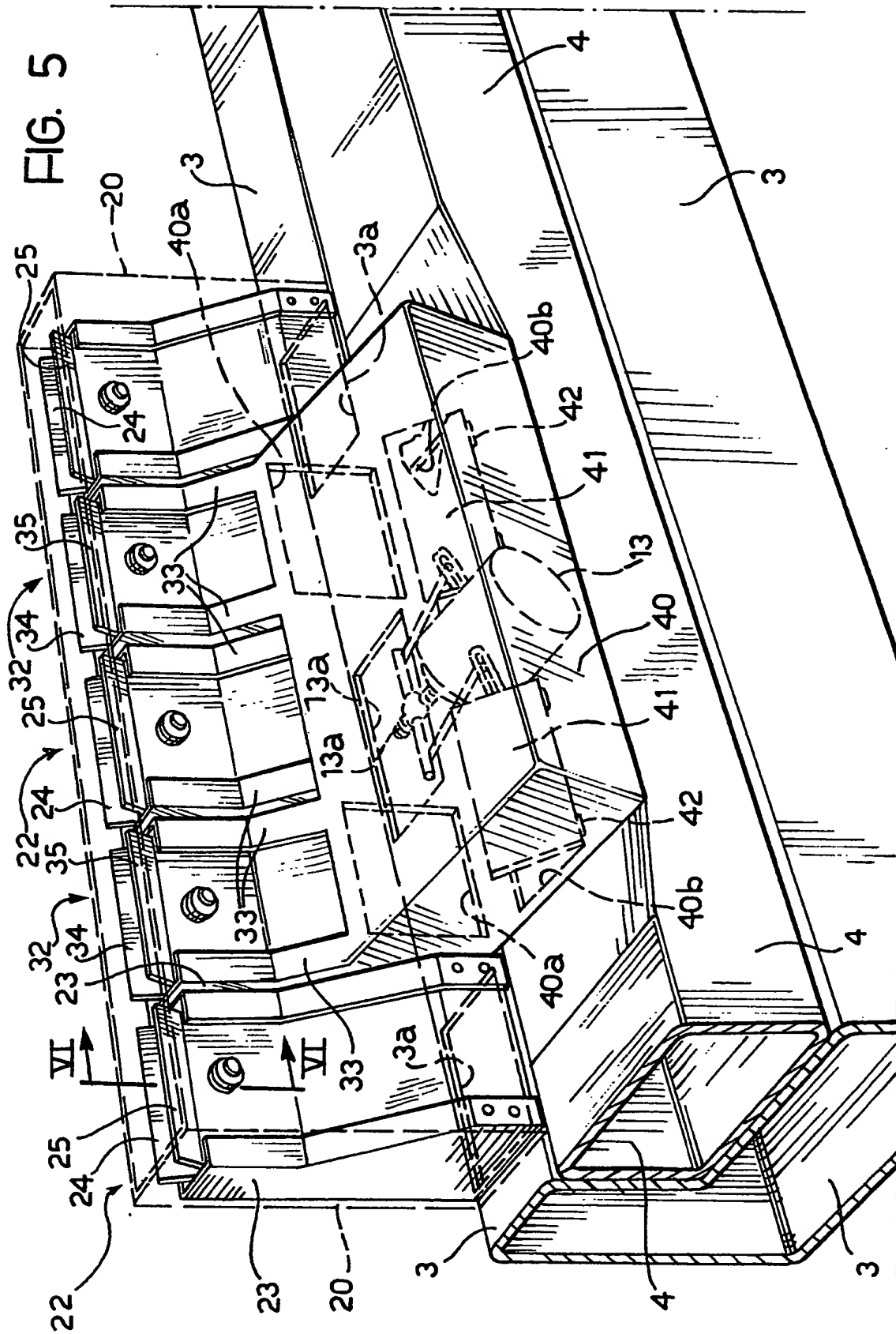


FIG. 6

